

Collaboration in a Data Analytics Curricula: An Active Learning Approach

Full Paper

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Abstract

In today's labor market, employers are seeking candidates with a combination of both workforce specific skills and data analytics skills knowledge. Students who complement their degree program can increase their earning potential and job prospects by doing so. To meet the needs of the students, a unique partnership between academic, industry, and the university career center was created for a Data Analytics and Decision making course. The aim of the pilot course was to introduce Liberal Arts students to Data Analytics strengthening their marketability and skill offerings for internships and post-graduate job opportunities. The use of various active learning techniques was implemented into the course curriculum and are discussed. Qualitative results suggest students like the active-learning-based approach, gained Data Analytic skills, and enhanced their knowledge of real-world use of Big Data for decision making.

Keywords

Active learning, Data Analytics, IS, pedagogy

Introduction

To compete in the era of big data will require analytically-focused employees to transform information and ultimately business insight for making better decisions (Goh and Sun, 2015; Informs, 2016). Industries who are growing their expertise in Data Analytics seek individuals with work-force specific skills and broad-based knowledge (Burning Glass, 2013). A 2011 study by the McKinsey Global Institute predicts that by 2018 the United States will face a shortage of more than 1.5 million managers, analysts, and other workers who are well-versed in the principles and use of analytics (Manika et. al., 2011)

A data analytics enhanced degree programs will be well positioned to succeed and shape the future of countless professions. Not only in IS related fields, but also in Public health, government, education, social policy, research, law, and medicine (Burning Glass, 2013) In today's world of globalization, business has experienced seismic changes. More than ever, the liberal arts are relevant for preparing the future generation of business leaders. It is critical that college and university liberal arts programs participate in shaping the field of data analytics (Weinberg, 2016).

Liberal Arts majors bring value in specialized knowledge that emphasizes intercultural competence, cultural sensitivity, as well as economic, political, social, and legal systems. Although according to the Georgetown Center on Education and the Workforce (2013) study reports Liberal Arts and Humanities (9.0%), Social Science (10.3%) and Arts (9.8%) graduates have among the highest unemployment rates of all college graduates. The overall unemployment rate for recent graduates is 7%.

Integration of high-skill demand Data Analytics complements any degree program. Data analysis and management can complement skills up to 56% and can offer upwards to \$6000 annual salary premium over less technical jobs often available to Liberal Arts students (Burning Glass, 2013). Nevertheless, complement skills do not secure a position, but adds value to make a candidate more compelling. Analytic skills can be gained through internships, active learning experiences in coursework or programs that offer a concentration in Data Analytics.

In response to this heightened transformation, a Data Analytics and Decision Making course was developed to address this gap. A collaboration emerged among the Data Analytics curriculum, industry partners, and university career center to launch a unique course targeted for 3rd and 4th year Liberal Arts students. This paper extends pedagogy research to infuse the use of multiple active learning techniques to engage students to learn about Data Analytics to inform decision making.

The paper is organized as follows. First, background literature on active learning is proposed. Second, design and implementation of active learning techniques in the Data Analytics course are discussed. Third, qualitative feedback from students is examined. Finally, conclusions are provided.

Theoretical Support For Active Learning

Active Learning is very broad and exists in a wide variety of techniques for student engagement. These type techniques can be used to supplement rather than replace lectures. The techniques can include everything from collaborative case study analysis, to short writing exercises in which students react to lecture material, to complex team exercises in which students apply course material to "real life" situations. In active learning, the student's involvement emphasizes deep learning and accountability (Bigg, 1999). Moreover, the instructor serves as a facilitator to create and assist student understanding, evaluating, and synthesis of course material (e.g. Lea, Stephenson and Troy, 2003; Yoder & Hochevar, 2005).

Prior research has shown in many disciplines such as life sciences, engineering, and statistics that active learning enabled positive student learning outcomes (Daniel and Braasch, 2013; Mckinney and Niese, 2016; Goacher et al., 2017). A myriad of research across IS and statistics suggests that higher level thinking is critical and helps to promote more effective application and transfer of course material (Dolinsky, 2001; Richmond and Hagan, 2011; Goacher et. al., 2017). Studies in analytically focused courses found increased gains in student perceptions, mean exam scores, increased confidence, and attitudes (Dolinsky, 2001; Goacher et. al., 2017). Research concludes that active learning designed exercises to learn database software enhanced student higher-level problem-solving development in the context of advanced real-world case studies and complex problem-solving. Daniel and Braasch (2013) study results implemented active learning techniques that resulted greater usage of students' statistical knowledge when answering questions and real-world applications of statistics was mentioned more often when compared to control students. Active learning techniques offer valuable benefits for students to promote critical thinking, reasoning, and problem-solving. Consequently, transfer-promoting approaches to learning can help students with statistical knowledge to flexibly apply concepts in more real-world situations.

Design And Implementation Of Active Learning

A number of active learning techniques were carefully chosen and used to teach the Data Analytics and decision-making course. The course was taught in a large public, well-established Mid-Atlantic university during the short January term course offering. During the January term students can earn 3 credit hours in a 10-day compressed time period. The course started on a Sunday and met every day except Sunday from 10am to 4pm each day. This was a pilot course with 23 students enrolled who were majority 3rd and 4th year students with a few 2nd year students. The discipline majors spanned across Foreign Affairs, Music, Public Health, and Economics, Public Policy and other Liberal Arts areas. Several students were pursuing statistics as a minor.

Traditional lecture was not abandoned; however, the course was developed with active learning as the focal pedagogical approach. A large number of active learning techniques were integrated into the course to create an optimal learning experience for students. The activities substantially involved students with the course content through group discussions, team exercises, reading, writing, hands-on exercises, listening, discovery, and reflection to embrace active learning. The next section describes the purpose of each active learning technique and its implementation.

Mini-Lecture

The lecture has long been a topic of rich debate in teaching. Lecture offers an efficient way to draw focus among complex ideas, significant volume of information, and introduces foundational knowledge for a topic. Though, this type delivery method can be somewhat one-sided and passive, mini-lectures offer value-add to provide an overview or “the big picture” in an abbreviated format to help students connect the dots. Mini-lectures can explain and synthesize key concepts in 10-15 minutes or less. The course material is presented in a concise, logical format to leverage the shorten duration and student’s attention span.

The mini-lecture format implemented in the course followed five key strategies:

1. Covered no more than 3 - 4 key points
2. Incorporated visuals into presentation slides such as videos, SmartArt, charts, and websites
3. Connected the topic to specific learning goals or key learning outcomes
4. Tied experiential learning activity to lecture
5. Closed each lecture with key points introduced at the start of the mini-lecture

Experiential Learning

Higher education has given significant attention to experiential learning as a means to improve learning. Borzak (1981) puts forth experiential learning as an instructional model to allow learners to engage in direct experience, reflection, analysis, and evaluation. Experiential learning theory describes the learning process as a four-stage cycle that includes: 1) concert experience, 2) reflective observation, 3) abstract conceptualization, and 4) active experimentation (Kolb and Kolb, 2005). Incorporating a hands-on activity created a learning space to reinforce data analysis skills. The major benefits of experiential learning are improved skills related to problem-solving, critical thinking, discussion, and decision making.

Big Data analysis exercises followed the mini-lecture to summarize the statistical method or data visualization exercise. Students were very anxious to apply the course knowledge to problem-solving and interpretative analysis. Each exercise not only focused on learning the analytical analysis but also, engaged real-life application and interpretation. The goal of the exercises was to give students a breath of analytic techniques to be successful in their team project. The exercises demonstrated how to manipulate and analyze data sets to inform decision-making. Sample topics covered included descriptive statistics, simple linear regression, multivariate regression, one-way ANOVA, various t-tests, and data visualization using SAS Studio and Tableau.

Flipped Classroom

Flipping the classroom is when students gain first exposure to new material outside of class via reading or lecture video. Class time is used to assimilate the knowledge through active learning activities. Mok (2014) teaching tip implemented a flipped classroom for an IS programming class. The author observed greater student engagement and students took on more ownership for their learning. Additionally, positive impact was observed in a flipped statistics course. The majority of the basic concepts moved outside the classroom making room for interactive activities during class time. students’ attitudes and performance were substantially improved in the class (Wilson, 2013).

During a typical day in the mini-lecture section, a particular data analytic concept was introduced. In the flipped sections, students were assigned to watch the relevant data analytic topic online prior to arriving in class. These video lectures averaged 25 – 35 minutes in length. During their viewing, students were encouraged to watch once, practice the concept, and note any questions for discussion in class the next day. There was no formal penalty for failing to watch the videos.

When class began, there were roughly 5 – 10 minutes of question and answer, during which students’ questions were answered about the video lecture and errors occurring during their practice. Students were instructed to start their exercises while the instructor walked around the classroom to answer any

questions that arose. Students found the videos to be very instructional and informative. The videos were very helpful to review multiple times to confirm understanding.

Case Study

The case studies used in the Data Analytics course require the students to read the assigned case and come to class prepared for discussion. Case studies provide a nice extension to the important concepts covered for a particular data analytics topic. An example case study used in class was for students to read “American Red Cross: Powerful and Breathtaking” (Niemela, 2014) article. A 15-minute video with actual company individuals was watched prior to the discussion. Students were able to hear more in depth decision making that took place to create a data-driven organization. Below are the question prompts that help guide the discussion.

1. Identify key challenges the Red Cross organization faced?
2. What decisions made the greatest impact on turning Red Cross into a data driven organization?
3. What types of data should the American Red Cross collect from their volunteers who perform the activities and why?
4. Pinpoint ways Red Cross can improve their data collection process.

Career Connection Speakers

Claims in higher education find a gap between real world experience and theory (Robertson, 2011). To bridge this gap, it is essential to create connections to facilitate a greater understanding of the real world data analysis and application. Students interest in careers are initially embedded within their experiences gained through their courses. Pedagogically, there is a need to provide students with opportunities for strengthening their career opportunity to enter the labor market. It is a value-added for students to gain professional career and real-world knowledge when told by industry speakers.

In this course, industry speakers were recruited from various companies whose job responsibilities were rooted in data analytics and attracted Liberal Arts majors. The speakers were provided a presentation outline and the course syllabus. Each presenter was asked to prepare a 45 – 50-minute presentation to the students to cover the following:

1. Education,
2. Company background,
3. Role in their company,
4. How the speaker landed their current job,
5. Required skills for their job role, and a
6. Short demo showing relevant practical application of an analytic tool of their choice.

A 10-15-minute Q & A session took place immediately following each industry speaker’s presentation. The students were very engaged to learn from those in the field of data analytics across a wide spectrum of industries where Liberal Arts majors are hired.

Team Capstone Presentation

A Capstone project was introduced to evaluate concepts the students learned in the course and to showcase their skills to employers for potential internships or jobs. Capstone projects are a summative evaluation in which the students are given an opportunity to demonstrate integrated knowledge and growth of the subject matter. These type projects are generally designed to encourage students to think critically, solve challenging problems, and develop skills in oral communication, public speaking, teamwork, planning, and goal-setting.

The project requirements were to develop a presentation for a fictional Senior Leadership Team (SLT) at a company. The presentation should tell a story summarizing findings from a Big data set. Students were

encouraged to create their stories to bring life to their analytics problem both visually and contextually for their audience. The presentation would provide enough information for the SLT to make informed decisions from their results. The Big Data sets were chosen from the instructor provided list or found by students. The course material, textbook, exercises, and discussions in class were to be used to develop the following Data Analytic approach for the team presentation:

1. Introduction:
 - a. Identify your team and team member roles
2. Frame the Problem:
 - a. What are the problems?
 - b. What do you seek to answer in this analysis (4 questions)?
 - c. Identify any known assumptions
 - d. Describe your data
 - e. Any additional material or support information to frame the problem can be used
3. Solving the problem:
 - a. Show important highlights from your analysis
4. Communicate your Results:
 - a. Clearly state and support your recommendations

The students were given requirements for the Capstone project at the start of the course. Teams were grouped based on the results of their Myers-Briggs Type Indicator (MBTI) assessment. The MBTI is one of the most popular psychological instruments used to describe and measure personality characteristics. It is commonly used in business and team building to encourage optimal communication and teamwork among different personalities. Each students' MBTI results was discussed collectively in the Building Effective Teams workshop led by a university career center specialist. The university career center administers the MBTI as part of its student Career assessment services.

Team composition was determined by the MBTI Team Facilitator Report analysis where each team comprised 3 or 4 students. The Team Facilitator Report provides the workshop planning and activity ideas as well as a Team Type Table that outlines preferences, attitude pairs, function pairs, energy and perception, judging and orientation, and temperament, and provides a comprehensive explanation of how each team is derived.

The pseudo SLT was comprised of invited industry partners who worked in the Data Analytics and provided feedback after each teams' presentation. Many of the individuals who served in this capacity participated in the speed interviews and networking activities. This type project helps students to develop their teaming skills, improve and refine their presentation skills, and target their presentation to a specific audience. Furthermore, students gain experience in managerial communication of analytical analysis.

Speed Interviews And Networking

The Speed Interviewing and Networking program purpose is to advance the professionalism and career preparedness of students. The process is much like the concept of speed dating. Speed Interviewing and Networking is a simulated interviewing experience for students. The students circulated through the interviewers in their assigned teams spending about five minutes per interviewer. Interviewers remain seated at the interview tables and the students circulate from one interviewer to the next. The interviewer asks the students a question, listens for the answer, and provides feedback to the student. A bell sounds to signify when it's time for the student to move to the next interviewer. Prior to the speed interviews, students and interviewers were assigned to tables to network and discuss their Capstone projects with the industry representatives.

Final Exam, Reflective Essay

After completion of the team Capstone project and presentations to the industry partners, a reflective essay was collected from the students for their final exam. Students were asked to thoroughly reflect on what they learned and experienced about Data Analytics in the course. The assignment was to write a two-page paper to address the question prompts listed.

1. Discuss what you have learned during the class and how it will assist you in achieving your career goals
2. Discuss what you found to be the most enjoyable and least gratifying in the course?
3. Given, your academic major, what types of careers would interest you and be a fit for you. Discuss your reasons.
4. Do think Data Analytics skills will improve or complement your potential to get a job or internship? Why or Why not?

Assessments

Big Data problem-solving, data analytics result interpretations, data exploration, and resume development exercises were included in the course as homework assignments. The aim of the individual homework is to help students apply the data analytic concepts and techniques covered in class. Nine homework assignments were completed by the students.

Qualitative Feedback

This section presents a summary of the qualitative feedback received from students.

1. The mixture of lectures, interactive learning, and guest speakers were a great combination.
2. This class was a strong complement to my major (economics).
3. In this course, I was able to learn how to interact with stakeholders.
4. The clearer the results presentation, the more likely that the quantitative analysis will lead to decision and actions- which are, after all, usually the point of the analysis in the first place.
5. It should be no surprise that the course was enjoyable for me overall as I was able to constantly take in new knowledge that is very relevant to my career goals. In particular, I enjoyed hearing guest speakers from industries ranging from clean energy to healthcare.
6. Data analytics skills will ultimately complement my ability to get a job.
7. For this reason, I found the most meaningful course activity involved meeting with recruiters and executives from real-world data analytic entities. I had previously gone on internship scouting trips, but found “speed dating” more conducive to legitimate discussion by both parties, which translates to a greater likelihood of getting an internship.
8. I greatly appreciated our discourse on “Communicating and Acting on Results”
9. The skills and concepts taught in STAT 3559 will undoubtedly put me at an advantage over other researchers when unpacking and explaining my findings.
10. Although I have learned a lot of important technical skills in this course, perhaps the most important lesson I have learned is not to shy away from any task.
11. Another extremely helpful portion of this course was the guest speakers. Not only were they engaging and interesting, but they also gave me a valuable glimpse into what my potential career path might hold for me.
12. I first learned how to apply the analytic process from question formulation, data gathering, data processing, and decision making to enhance my critical thinking skills and decision-making processes.

13. I was able to learn how to work with a team and apply it to a real-world data set.
14. Lastly, I absolutely believe that the data analytic skills will improve my potential to get an internship for this upcoming summer.
15. We were never rushed for time and were able to work on assignments at our own pace.
16. I believe the pace of the class accommodated students ranging from all difference backgrounds. We were able to learn step-by-step, how to use Tableau and SAS and that allowed for students to obtain a solid foundation.
17. I think taking this class not only has made me a more appealing candidate when applying to jobs but has given me applicable skills that I can utilize no matter what career path I decide on.
18. I would have to say that the most enjoyable part of it was learning how to use SAS and Tableau to make data comprehensible. I enjoyed working on exercises in and out of class, as I found I was able to understand how to use the two program we studied quite quickly, which was very gratifying.
19. Possessing data analytics skills has increased my job prospects exponentially.
20. I think the broad scope of the course made this possible as many other statistics classes are very focused and crate a silo within which to work. The capstone project was a perfect example of this because it gave us a lot freedom to approach a topic of our choice and go through the stages from conception to execute of the project.
21. I absolutely enjoy every guest speakers' presentation. They bring valuable information about the workforce and job prospects from their own experience. The fact that they came from different industries gives me a broad view of how applicable data analytics is in the real workplace regardless of what company I work for.

Conclusions

In the current age of big data, companies rely on data-driven decision making as a transformational component of their core operations. New college hires armed with a Liberal Arts background and specific expertise in data analytics can turn data into intelligence for decision making. This is a key skill sought by business and industry to develop the key narrative for business decisions. These students demonstrated a leap of understanding in data analytics that can impact their future career opportunities. This curricula integration and approach proved to enhance student data analytic skills and career options.

The active learning techniques provided an optimal learning environment to motivate and increase critical thinking, and engagement. This approach to learning proved to be very rewarding and created strong interest for the Data Analytics topic. It is hoped other universities and colleges will implement collaborations to bridge the data analytics skills gap.

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